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ABSTRACT

Reciprocal peer tutoring (RPT) is a cooperative learning strategy that capitalizes on the benefit students receive from preparing to tutor one another (Pigott, Fantuzzo, and Clement, 1986; Wolfe, Fantuzzo, and Wolfe, 1986). In this study, the effects of RPT on the academic achievement, academic self-efficacy, and test anxiety of 47 undergraduate students were investigated. Students developed a series of test questions, used these questions to quiz each other prior to unit examinations, and provided corrective feedback to the questions developed. Findings indicated that the RPT procedure had no statistically significant effects on either achievement or self-efficacy, but did increase test anxiety. Three tables present study findings. An appendix, with an additional table, provides information about the instruments used. (Contains 32 references.) (Author/SLD)

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An Investigation of the Effects of Reciprocal Peer Tutoring on Achievement, Self-efficacy, and Test Anxiety

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ED 383 756

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Abstract

Reciprocal peer tutoring (RPT) is a cooperative learning strategy which capitalizes on the benefit students receive from preparing to tutor one another (Pigott, Fantuzzo, & Clement, 1986; Wolfe, Fantuzzo, & Wolfe, 1986). In this study, we investigated the effects of RPT on the academic achievement, academic self-efficacy, and test anxiety of undergraduate students. Students developed a series of test questions, used these questions to quiz each other prior to unit examinations, and provided corrective feedback to the questions developed. Findings indicated that the RPT procedure had no statistically significant effects on either achievement or self-efficacy, but did decrease test anxiety.

An Investigation of the Effects of Reciprocal Peer Tutoring on Achievement, Self-efficacy, and Test Anxiety

Peer tutoring is a form of cooperative learning which has been effective at increasing student achievement at various educational levels (Bargh & Schul, 1980; Greenwood, Carta, & Hall, 1988; Jenkins & Jenkins, 1985; Sherman, 1991; Slavin, 1991). Research on peer tutoring indicates that both students participating in the process, the tutor and the tutee, demonstrate gains in achievement from participating in this process. Several studies have shown, however, that the tutor usually benefits more than the tutee because of the preparation for the tutoring process (Allen & Feldman, 1973; Annis, 1983; Bargh & Schul, 1980; Benware & Deci, 1984).

Reciprocal peer tutoring (RPT) was developed by Fantuzzo and his associates as a means of capitalizing on the preparation students must undergo in order to tutor other students (Pigott, Fantuzzo, & Clement, 1986; Wolfe, Fantuzzo, & Wolfe, 1986). In the RPT strategy each student in a pair plays both the role of tutor and tutee. The RPT process enables students to provide instruction, evaluation, and reinforcement to one another, thereby creating mutual assistance and social support among participants (Fantuzzo, King, & Heller, 1992; Pigott et al., 1986; Fantuzzo, Riggio, Connelly, & Dimeff, 1989).

When RPT is used in a collegiate setting, students are paired with a partner throughout the term and each student generates a series of test questions, administers these questions to their partner, and provides tutelage to the partner prior to unit tests. Students generate questions and administer their tests outside of class time, and bring the completed test to the instructor of the course on the day of the examination. RPT items are not viewed by the instructor until after students complete the procedure. Results of studies with college students indicate that RPT has a positive effect on achievement, leads to decreases in stress and anxiety, and increases course satisfaction (Fantuzzo, Dimeff, & Fox, 1989; Fantuzzo, Riggio, Connelly, & Dimeff, 1989; Riggio, Fantuzzo, Connelly, & Dimeff, 1991).

Most studies of RPT are consistent in their findings concerning academic performance: students who study with RPT demonstrate a better understanding of the material tested. This work, however, is limited to either populations of elementary/middle school children (Fantuzzo et al., 1992; Fantuzzo, Polite, & Grayson, 1990; Pigott et al., 1986; Pigott, Fantuzzo, Heggie, & Clement, 1984; Wolfe, Fantuzzo, & Wolter, 1984), or undergraduate psychology students (Fantuzzo, Dimeff, et al., 1989; Fantuzzo, Riggio, et al., 1989; Riggio et al., 1991). Contrary to most of the previous research, Griffin and Griffin (1994) found that RPT techniques did not improve academic achievement in a graduate-level educational research course. Despite this finding, graduate students reported that they believed the RPT procedure was beneficial to their understanding of course concepts.

If RPT does lead to increases in achievement of targeted course concepts, it follows that improvement in student self-efficacy should also occur. One source of self-efficacy is outcome of performance (Bandura, 1986). That is, if students have experienced success in a domain, they are likely to have higher self-efficacy in that domain. The RPT procedure gives students an opportunity to practice test taking skills and receive feedback immediately prior to completing a unit examination. This practice activity is predicted to lead to higher feelings of self-efficacy for the unit examination as well as a lower level of test anxiety. Furthermore, research has shown that strategy instruction can influence self-efficacy. That is, self-efficacy is promoted when one understands and applies a strategy that can enhance achievement and leads to a greater sense of control over learning outcomes (Licht & Kistner, 1986; Schunk, 1989). RPT is a cooperative strategy for learning which may lead to enhanced achievement outcomes. Cooperative learning experiences, as compared with individualistic experiences, can promote a greater sense of personal efficacy (Johnson, Johnson, Pierson, & Lyons, 1985; Johnson, Johnson, & Scott, 1978).

Another aspect of motivation involves students' affective or emotional reactions to a task (Pintrich & DeGroot, 1990). In a school setting one of the most important reactions centers around test anxiety (Wigfield & Eccles, 1989). Pintrich and DeGroot (1990) found that test anxiety was not significantly related to the use of cognitive strategies but was negatively related to

self-efficacy and exam and quiz performance. This outcome corresponds with findings of Benjamin, McKeachie, and Lin (1987) who proposed that in some students test anxiety during examinations causes students concern about their capabilities, which can actually interfere with effective performance. RPT has been shown to lead to increases in performance and, thus, we are predicting it will lead to an increase in self-efficacy. A subsequent prediction is that increased self-efficacy will lead to lower levels of test anxiety when RPT is utilized.

In this study we attempted to extend the generalizability of RPT beyond elementary school students and undergraduate psychology students by investigating the effects of RPT on test anxiety and self-efficacy in undergraduate education majors.

Method

Participants

Forty-seven undergraduate students enrolled in two sections of a human growth and development course taught in the college of education participated in the study. Most of the students were education majors or waiting to be admitted to the college of education, while the remaining 15% were pre-recreational, occupational, or physical majors. The course was offered at a medium-sized, regional university located in the southeast, and both sections were taught by the first author of this study. Approximately 90% of the students were of sophomore class standing and most were from rural areas. About 70% of the students were women, and 81% were White. Results of a two-group t-test indicated no statistically significant differences on pretest performance between the two groups of students (class A, $\underline{M} = 12.04$, $SD = 3.18$; class B, $\underline{M} = 11.61$, $SD = 3.12$; $t = 0.47$, $df = 45$, $p = 0.64$).

The three previous RPT studies which examined undergraduate performance had effect sizes of 1.14 (Fantuzzo, Dimeff, et al., 1989), 0.98 (Fantuzzo, Riggio, et al., 1989), and 0.57 (Riggio, et al., 1991). The power in this study to detect the smallest of these three effect sizes was slightly above .80, and the power to detect the average of the three effect sizes exceeded .95 (Cohen, 1988; Lipsey, 1990).

Instruments

The pretest for this study consisted of 30 items, 5 for each of 6 chapters. The unit tests served as post measures of the effects of RPT on achievement. Though the unit tests assessed a total of 10 chapters, only those items measuring content from the 6 chapters assessed on the pretest (total items = 74) were included as part of the posttest scores. Students wrote 5 items for each of the 6 chapters included on the pretest, for a total of 30 items written and studied in the RPT strategy. Each item included on the unit tests corresponded to a course objective. Objectives were distributed to students and content for most of the objectives was discussed during class sessions. These measures should ensure the content validity of the posttest measure.

Test anxiety and self-efficacy were measured by the Self-efficacy and Test Anxiety Scale (STAS), which provides a measure of situation-specific test anxiety (Griffin, 1994). The instrument was administered prior to each of the three in-class examinations. The alpha reliability coefficients for the two constructs, self-efficacy and test anxiety, were above .90 for each of the three exams. Exploratory factor analysis indicated that items were measuring concepts as two factors, test anxiety and self-efficacy, and that these two factors accounted for 70% of the observed variance (see Appendix A).

Design and Procedures

A counterbalanced, repeated measures design was utilized in this study. The counterbalanced aspect involved using intact groups, both of which received the treatment but in varying sequences (Sowell & Casey, 1982). The repeated measures aspect of the design involved measuring test performance, self-efficacy, and test anxiety three times each in both groups.

On the first day of class students completed a 30-item pretest over concepts from 6 of the 10 course chapters. These data were analyzed using a t-test to make sure there were no initial differences between the groups.

Reciprocal peer tutoring procedures were implemented as follows. Students in the treatment group were instructed to write 5 test items from each of two chapters for three unit examinations. These items were submitted for review by the instructor of the course approximately one week

prior to the unit examination. Written explanations of the correct response were included on a separate page to ensure that students knew and could explain to their partners the correct response to the RPT items. At this time the instructor primarily examined the items to ensure that each item had only one correct response, was content-valid, and was unambiguous. If items were unclear, had more than one correct response, or lacked content validity, students were instructed to revise and re-submit the items.

Students were randomly paired for the RPT sessions. Students in class A completed the RPT procedure twice, for exams one and three, and students in class B participated in RPT once, on the second examination. Students completed the RPT activities during the class periods in which the exams were administered. They were allowed to work on RPT for up to one hour, though all students typically finished within 30 minutes. Students exchanged RPT items with their partners, responded to the items, and then returned the completed tests to the writers for feedback. For each incorrect response or any other response for which the tutee required clarification, the tutors provided explanations and assisted the tutees in understanding the correct response. Students in both classes completed the STAS immediately prior to each unit examination, and immediately after the RPT session for those participating in RPT. Unit examinations included those items presented on the pretest as well as other items representative of the content in the respective chapters.

Course procedures were identical for the two classes participating in the study with the exception of the timing of reciprocal peer tutoring. To reduce possible experimenter effects, both the content and the delivery of the material were consistent across the two courses. Both classes met on the same day with a two hour break separating them, thus facilitating consistency of presentation.

Results

Three outcomes of interest were measured: achievement, self-efficacy, and test anxiety. The posttest achievement, situation-specific test anxiety, and academic self-efficacy scores were analyzed using a 3 x 2 (exam and treatment) repeated measures analysis of variance (Edwards,

1972; Maxwell & Delaney, 1990). The analysis of variance results for the treatment effect on achievement scores was not statistically significant ($F = 1.22$, $df = 1, 90$, $p > .05$, $MSE = 82.56$) and there were no statistically significant interactions ($p > .05$). Upon close examination of these results, presented in Table 1, one notes a slight upward trend over time in Glass' d, a measure of effect size. That is, as students used RPT throughout the quarter, the treatment did seem to have more effect with each subsequent use. Note, however, that even on the last RPT administration this upward trend was not practically or significantly significant as the .51 SD difference on Exam 3 translates to a difference of approximately 4 percentage points difference between the groups.

The analysis of variance of the treatment effect on test anxiety was statistically significant ($F = 5.00$, $df = 1, 90$, $p < .05$, $MSE = 0.43$), and there was no statistically significant interaction between the treatment and the exams ($F = 1.53$, $df = 2, 90$, $p > .05$). As the quarter progressed, student anxiety decreased with each unit examination (see Table 2).

Self-efficacy scores were also examined using a 3 x 2 (exam and treatment) repeated measures analysis of variance. The results for the treatment were not statistically related to self-efficacy at any conventional significance level ($F = 1.92$, $df = 1, 90$, $p > .05$, $MSE = 0.53$) and there were no statistically significant interactions ($p > .05$).

Discussion

Analyses of data gathered in this study indicate that RPT had no statistically significant effect and little practical effect on achievement or self-efficacy, yet it did seem to reduce test anxiety. While these findings are contrary to those of earlier studies investigating the use of RPT with undergraduate psychology students (Fantuzzo, Dimeff, & Fox, 1989; Fantuzzo, et al., 1989; Riggio, et al., 1991), they are consistent with findings investigating RPT with graduate education majors (Griffin & Griffin, 1994). Given these contradictory findings, one must ask why RPT did not improve achievement or self-efficacy with this sample.

First, consider the possibility of ceiling effects, type II error, and generalizability. Scores on the unit examinations ranged from approximately 72% correct to 79% correct (see Table 1), with standard deviations ranging from 7.78 to 12.04. It is apparent from these scores that room

for improvement did exist, thus making a ceiling effect highly unlikely. The possibility of a type II error can never be ruled out when statistically significant findings are not found, yet power analysis indicated that we had power of .80 to detect the smallest previously observed effect size, thus making the type II error explanation of the findings unlikely as well. It is also possible that RPT simply does not generalize beyond those populations previously investigated.

Another plausible explanation for the differences in the findings of the current study and those of Fantuzzo and associates (Fantuzzo, Dimeff, & Fox, 1989; Fantuzzo, et al., 1989; Riggio, et al., 1991) lies in the slight modifications made to the methodology employed in this study and in that employed in earlier investigations of a collegiate population. In previous investigations, students wrote items and administered tests outside of class without any intervention by the course instructor. That is, the quality and validity of the items was not investigated prior to the RPT procedure, and was not reported on in any of the studies. Furthermore, no discussion of time spent in the tutoring process was offered. In this study, we tried to control for quality of items and time engaged in tutoring, and thus modified earlier methodology by (1) requiring students to submit items for review prior to administering them to their RPT partners; (2) requesting that students revise any items which had blatant problems, such as more than one correct answer, lack of content validity, or ambiguous wording; and (3) setting aside time in class immediately prior to the unit examination in which students could administer their RPT tests. We allowed students time in class to administer their tests to each other to ensure that students did engage in the RPT procedure. Thus we reduced the possibility that students were too busy to get together with their partners outside of class and completed their own tests rather than administer them to their partners before submitting them to the instructor.

Our intention in implementing these changes was, of course, to increase control over the experimental manipulation. It is possible, however, that we undermined some of the benefits of RPT experienced in earlier studies by these modifications. In previous studies, the RPT items were not examined prior to the tutoring session; recall that we examined these items to correct any blatantly poor or invalid items. It is possible that students in the previous studies all wrote

acceptable test items, or perhaps they did write some poor items but these poor items created more, rather than less, dialog and learning. That is, if the items were ambiguous, had more than one correct response, or lacked content validity, students may have spent more time discussing and explaining the content of the items and thus learned more through working with poor test items.

Perhaps also, our attempt to ensure the completion of the RPT process by allowing time in class to take the tests actually created less time for learning. That is, if students completed the RPT procedure outside of class prior to taking a unit examination, and they did poorly on the RPT items, they may have taken their performance as an indicator that they needed to study more before they took the unit exam. Poor performance on RPT may have increased incentive to study. Our modification, however, does not allow for much, if any, extra study time between taking the RPT tests and the unit exams. Within 10-15 minutes of completing RPT, students completed the corresponding unit examination. One possible way to ensure control over the completion of the RPT process and to allow extra study time if needed would be to allow time at the end of the class period immediately prior to the period in which the unit exam is to be administered for completion of RPT.

Conclusion

The findings of the current study do not support earlier findings of RPT with college undergraduate students (Fantuzzo, Dimeff, & Fox, 1989; Fantuzzo, et al., 1989; Riggio, et al., 1991). Despite the lack of a statistical effect on achievement, test anxiety for the RPT group was statistically lower than in the non-RPT group, and decreased over the course of the quarter as students became more accustomed to using the RPT procedure. Self-efficacy was not enhanced by RPT, but this finding is not surprising since self-efficacy is largely influenced by outcomes of past performance, and performance was not enhanced with RPT procedures. Despite this finding, however, RPT seemed to have some positive outcomes on motivation, as shown by the lowering of test anxiety in the RPT groups.

Future studies of RPT should continue to examine the efficacy of the procedure with students in psychology, education, and other disciplines. The modifications we introduced to the

reciprocal peer tutoring technique should also be further investigated. Despite the lack of statistically significant effects of RPT on achievement in this study, the outcome of decreased test anxiety is certainly important and should be more closely examined to validate its existence.

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Table 1: Posttest Performance

	Statistic	Exam 1	Exam 2	Exam 3
RPT	M	75.35	76.46	79.44
	SD	9.75	10.17	7.78
	n	24	23	24
non-RPT	M	72.64	76.29	75.18
	SD	11.64	12.04	8.28
	N	23	24	23
Glass' d		.23	.01	.51

Note: Posttest Ms are reported as percent correct.
Glass' d is defined as $(M_{RPT}-M_{non\text{-}RPT})/SD_{non\text{-}RPT}$. Higher means indicate better performance.

Table 2: Test Anxiety

	Statistic	Exam 1	Exam 2	Exam 3
RPT	M	4.83	4.40	4.34
	SD	1.30	1.75	1.42
	n	24	23	24
non-RPT	M	4.83	4.72	4.76
	SD	1.27	1.31	1.89
	n	23	24	23
Glass' d		0.00	-0.24	-0.22

Note: Glass' d is defined as $(M_{RPT}-M_{non\text{-}RPT})/SD_{non\text{-}RPT}$. Lower means indicate less test anxiety.

Table 3: Academic Self-efficacy

	Statistic	Exam 1	Exam 2	Exam 3
RPT	M	4.81	4.59	4.26
	SD	0.75	1.28	1.04
	n	24	23	24
non-RPT	M	4.93	4.10	4.48
	SD	1.09	1.10	1.32
	n	23	24	23
Glass' d		-0.11	0.45	-0.17

Note: Glass' d is defined as $(M_{RPT}-M_{non\text{-}RPT})/SD_{non\text{-}RPT}$. Higher means indicate higher levels of academic self-efficacy.

Appendix A

Most instruments which measure students' test anxiety and academic self-efficacy are designed to tap global or overall components of these constructs. That is, the instruments are developed with the notion that students provide responses according to general feelings in relation to test anxiety and academic self-efficacy (e.g., see Sarason, 1978; Benson & El-Zahhar, 1994; Speilberger, Gonzalez, Taylor, Algaze, & Anton, 1978)

Students who are about to sit for an examination may experience different levels of anxiety or self-efficacy from the general levels established by global instruments. Thus, current measures of these two constructs may not measure situation-specific test anxiety or academic self-efficacy.

The instruments used in this study were designed to provide a measure of students' situation-specific test anxiety and academic self-efficacy. The instruments were administered a few minutes prior to an in-class examination. Thus, any anxiety or lack of self-efficacy about performance due to the specific nature of the exam students were about to take would be captured by these instruments.

To measure the situation-specific nature of test anxiety and academic self-efficacy, items on the instruments were worded such that they pertained to the specific examination that was about to be administered. Consider, for example, the following item for test anxiety:

•I feel restless and fidgety because of the exam I am about to take.

The following item illustrates the situation-specific nature of academic self-efficacy:

•This exam may cover difficult concepts, but I am sure that I can provide good answers to the questions on these concepts.

Nine items were developed to measure test anxiety, and eight items were developed to measure academic self-efficacy. Likert scaled responses to all items ranged from 1 (not at all true of me) to 7 (very true of me).

The instruments were administered prior to each of the three in-class examinations. The reliabilities for the two constructs are presented below.

Table A1
Alpha reliability for Test Anxiety and Academic Self-Efficacy.

	Exam 1[a]	Exam 2[a]	Exam 3[a]	All Exams[b]
Test Anxiety	.900	.948	.968	.943
Academic Self-Efficacy	.906	.963	.961	.950

[a] Alpha reliabilities based on an n of 47.
[b] Alpha reliabilities based on an n of 141.

The alpha reliability coefficients show that the responses to the items correlated well. Exploratory factor analysis of all responses (all exams combined, n = 141) indicated that the items were measuring distinct concepts as two factors. Two factors were extracted and the items loaded precisely as one would expect--all test anxiety items on factor 1 and all academic self-efficacy items on factor 2.

The two factors accounted for 70% of the observed variance. An oblique rotation was used since previous research on test anxiety and academic self-efficacy has shown the two to be negatively correlated. Results of this factor analysis confirmed these results. The correlation between the two constructs was -.30. The pattern and structure matrices (based on oblimin rotation) are presented on the following page.

Pattern Matrix:

Items	FACTOR 1 (Test Anxiety, TA)	FACTOR 2 (Academic Self-Efficacy, SE)
TA8	.87391	-.05448
TA1	.87363	-.01208
TA5	.87101	.07386
TA9	.86919	-.02758
TA6	.85896	-.05337
TA7	.75283	-.18922
TA4	.74927	-.12598
TA3	.70947	.27696
TA2	.60119	-.20961
SE8	-.02806	.91135
SE3	-.06588	.86336
SE6	.08087	.85198
SE4	-.12522	.82479
SE7	-.02432	.81641
SE2	-.07396	.81020
SE5	.09133	.79944
SE1	-.03833	.79238

Structure Matrix:

Items	FACTOR 1 (Test Anxiety, TA)	FACTOR 2 (Academic Self-Efficacy, SE)
TA9	.88984	-.31003
TA7	.87726	-.28175
TA1	.87716	-.26755
TA6	.87457	-.30455
TA5	.84941	-.18084
TA8	.80816	-.40936
TA4	.78611	-.34509
TA2	.66248	-.38541
TA3	.62848	.06949
SE8	-.29456	.91956
SE3	-.31835	.88263
SE4	-.36641	.86141
SE2	-.31088	.83183
SE6	-.16826	.82833
SE7	-.26305	.82352
SE1	-.27004	.80359
SE5	-.14245	.77274

Readers wishing a more thorough discussion of this instrument should write the second author.